DEVELOPER SUPPLY CONTAINER AND ELECTROPHOTOGRAPHIC IMAGE FORMING APPARATUS

FIELD OF THE INVENTION AND RELATED ART

The present invention relates to a developer supply container removably mountable in the main assembly of an electrophotographic image forming apparatus, and also to an electrophotographic image forming apparatus.

Here, an electrophotographic image forming apparatus means an apparatus for forming an image on recording medium (for example, recording paper, OHP sheet, etc.) with the use of an electrophotographic image forming method. As for examples of an electrophotographic image forming apparatus, there are electrophotographic copying machines, electrophotographic printers (laser beam printers, LED printers, etc.), facsimileing machines, word processors, etc.

Generally, an electrophotographic image forming apparatus uses developer in the form of microscopic particles in order to form an image. Thus, it is common practice to supply the main assembly of an electrophotographic image forming apparatus with developer with the use of a developer supply container, as the developer in the main assembly of an image forming apparatus is consumed.

Developer is in the form of extremely fine particles as described above. Therefore, in order to prevent developer from scattering into the air during a developer supplying operation, a developer supply container is disposed in the image forming apparatus main assembly, and developer is supplied into a process cartridge in small increments from the developer releasing hole of a developer supply container, as image formation continues. This method of supplying the image forming apparatus main assembly with developer has been known (for example, Japanese Laid-open Patent Application 2002-6608 and U.S. Patent 6,564,029).

SUMMARY OF THE INVENTION

The present invention is the result of the further development of the above described prior technologies.

More specifically, the present invention is the result of the further development of the positioning structure for positioning a developer supply container relative to the main assembly of an image forming apparatus when mounting the developer supply container into the apparatus main assembly.

The primary object of the present invention is to provide a developer supply container removably mountable in the main assembly of an

electrophotographic image forming apparatus, and an electrophotographic image forming apparatus in which the above described developer supply container is removably mountable.

Another object of the present invention is to provide a developer supply container, which can be left in the main assembly of an electrophotographic image forming apparatus to supply the developer into the developer container of a process cartridge, and an electrophotographic image forming apparatus in which such a developer supply container is removably mountable.

Another object of the present invention is to provide a developer supply container, which is accurately positioned relative to the main assembly of an electrophotographic image forming apparatus when mounted into the electrophotographic image forming apparatus main assembly, and an electrophotographic image forming apparatus which employs such a developer supply container.

Another object of the present invention is to provide a developer supply container, which is reliably positioned relative to the main assembly of an electrophotographic image forming apparatus when mounted into the electrophotographic image forming apparatus main assembly, and an electrophotographic image forming apparatus which employs such a developer

supply container.

Another object of the present invention is to provide an inexpensive developer supply container, which can be accurately positioned relative to the main assembly of an electrophotographic image forming apparatus when mounted into the electrophotographic image forming apparatus main assembly, and an electrophotographic image forming apparatus which employs such a developer supply container.

Another object of the present invention is to provide a developer supply container, which can be accurately positioned relative to the main assembly of an electrophotographic image forming apparatus, with the use of a simple structural arrangement, when mounted into the electrophotographic image forming apparatus main assembly, and an electrophotographic image forming apparatus which employs such a developer supply container.

Another object of the present invention is to provide a developer supply container, which is accurately positioned relative to the main assembly of an electrophotographic image forming apparatus by the container guides of the apparatus main assembly when mounted into the electrophotographic image forming apparatus main assembly, and an electrophotographic image forming apparatus which employs such a developer supply container.

Another object of the present invention is to provide a developer supply container, which allows the container guides of the main assembly of an electrophotographic image forming apparatus to have both the positioning function for accurately positioning the developer supply container relative to the apparatus main assembly, and the guiding function for guiding the developer supply container when the developer supply container is mounted into the electrophotographic image forming apparatus main assembly, and an electrophotographic image forming apparatus which employs such a developer supply container.

Another object of the present invention is to provide a developer supply container comprising: a container positioning portion which is located at the leading end the container, in term of the direction in which the container is mounted, and engages with the container positioning portion of the main assembly of an electrophotographic image forming apparatus in order to be accurately positioned relative to the main assembly so that the developer supply container is accurately positioned relative to the main assembly, when the container is mounted into the main assembly; and first and second container guides, the trailing ends of which, in terms of the container mounting direction, are supported by a pair of container guides of the main assembly so that the developer supply

container is accurately positioned relative to the main assembly, when the developer supply container is mounted into the main assembly, and also to provide an electrophotographic image forming apparatus which employs such a developer supply container.

These and other objects, features, and advantages of the present invention will become more apparent upon consideration of the following description of the preferred embodiments of the present invention, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a side view of the electrophotographic color image forming apparatus in the first embodiment of the present invention.

Figure 2 is a side view of the process cartridge and developer supply container in the first embodiment of the present invention.

Figure 3 is an external perspective view of the image forming apparatus shown in Figure 1.

Figure 4 is a sectional view of the process cartridge in the main assembly of the electrophotographic image forming apparatus.

Figure 5 is a sectional view of the developer supply container in the main assembly of the electrophotographic image forming apparatus.

Figure 6 is a perspective view of the developer supply container in the first embodiment of the present invention.

Figure 7 is a perspective view of the developer supply container shown in Figure 6, which is being mounted into the main assembly of the electrophotographic image forming apparatus.

Figure 8 is a perspective view of the development supply container shown in Figure 6.

Figure 9 is a side view of the development supply container in the main assembly of the electrophotographic image forming apparatus.

Figure 10 is a plan view of the closing member.

Figure 11 is a schematic plan view of the development supply container, and its adjacencies, in the main assembly of the electrophotographic image forming apparatus.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

First, the electrophotographic color image forming apparatus in the first embodiment of the present invention will be described with reference to the appended drawings. In the following descriptions, the lengthwise direction means the direction in which a development supply container is mounted into the main assembly of the electrophotographic image forming

apparatus, and is intersectional with (virtually perpendicular to) the direction in which a recording medium 2 is conveyed. It also means the direction parallel to the axial direction of the electrophotographic photoconductive drum (which hereinafter will be referred to as photoconductive drum 7). The left and right sides mean the left and right as seen from the direction from which the recording medium 2 is conveyed. Further, the top and bottom sides of the developer supply container mean the top and bottom sides of the development supply container when the development supply container is in the image forming apparatus main assembly.

[General Structure of Image Forming Apparatus]

First, referring to Figure 1, the general structure of the electrophotographic image forming apparatus will be described.

Figure 1 is a drawing for describing the general structure of a color laser beam printer, which is an example of a color image forming apparatus.

The image forming portion of the electrophotographic image forming apparatus (color laser beam printer) in this embodiment employs four process cartridges 10 (10Y, 10M, 10C, and 10K corresponding to yellow, magenta, cyan, and black color components, respectively), each of which has an electrophotographic photoconductive member 7 (which hereinafter

will be referred to as "photoconductive drum") in the form of a drum. The four process cartridges 10 are disposed in parallel and are aligned in the horizontal direction. The image forming portion has four exposing means 1 (1Y, 1M, 1C, and 1K) (laser beam optical scanning system), which also are disposed in parallel and are aligned in the horizontal direction. The four exposing means 1 are located above the process cartridges 10 (10Y, 10M, 10C, and 10K), being roughly vertically aligned one for one with the four process cartridges 10.

Designated by a referential number 10Y is a cartridge for developing an electrostatic latent image with the use of yellow developer, and designated by a referential number 10M is a cartridge for developing an electrostatic latent image with the use of magenta developer. Designated by a referential number 10C is a cartridge for developing an electrostatic latent image with the use of cyan developer, and designated by a referential number 10K is a cartridge for developing an electrostatic latent image with the use of black developer.

Below the above described image forming portion, there are a feeding means for feeding the recording medium 2 into the main assembly, an intermediary transfer belt 4a for transferring a developer image formed on the photoconductive drum 7,

onto the recording medium 2, and a secondary transfer roller 4d for transferring the developer images on the transfer belt 4a, onto the recording medium 2.

Also located below the image forming portion are a fixing means 5 for fixing the developer images to the recording medium 2 after the transfer of the developer images onto the recording medium 2, and discharging means 3h and 3j for discharging the recording medium 2 out of the image forming apparatus main assembly and accumulating it.

The recording medium 2 is a piece of recording paper, OHP sheet, fabric, or the like.

The image forming apparatus in this embodiment is a cleaner-less apparatus. Thus, the transfer residual toner, that is, the toner remaining on the photoconductive drum 7 after transfer is taken in by the developing means 10. Therefore, the process cartridges 10Y, 10M, 10C, and 10K are not provided with a cleaner dedicated to the recovery of the transfer residual toner.

Next, the structures of the various portions of the image forming apparatus will be described in detail in the logical order.

[Feeding Portion]

The feeding portion (feeding means) is a portion for feeding the recording medium 2 into the image forming apparatus main assembly and conveying it

to the image forming portion. It comprises: a feeding cassette 3a which holds a plurality of recording mediums 2; a feeding roller 3b; a retard roller 3c for preventing two or more recording mediums 2 from being fed at the same time; a guide 3d; and a registration roller 3g.

The recording medium 2 is conveyed to the registration roller 3g by the conveying rollers 3e and 3f while being guided by the guide 3d.

[Process Cartridge]

Referring to Figure 2, each of the process cartridges 10 (10Y, 10M, 10C, and 10K) comprises the photoconductive drum 7, a charging means 8, and the developing means 10, which are integrally disposed in the cartridge shell, with the charging means 8 and developing means 10 being disposed in the adjacencies of the peripheral surface of the photoconductive drum 7. The process cartridges 10Y, 10M, 10C, and 10K can be easily removed from the main assembly of the electrophotographic image forming apparatus (which hereinafter will be referred to as "apparatus main assembly"). Thus, as the service life of the photoconductive drum 7 in a given process cartridge expires, the process cartridge is to be replaced by a user.

The photoconductive drum 7 is provided with a drum flange 7b, which is solidly fixed to one of the

lengthwise ends of the photoconductive drum 7 (Figure 4), that is, the inward end of the photoconductive drum 7 in Figure 2. Also, the photoconductive drum 7 is provided with a flange 7d, which is solidly fixed to the front end of the photoconductive drum 7, from which the photoconductive drum 7 is not driven. Further, the photoconductive drum 7 has a drum shaft 7a, which penetrates the centers of the flanges 7b and 7d. The drum shaft 7a, and flanges 7b and 7d rotate together. In other words, the photoconductive drum 7 rotates about the axial line of the drum shaft 7a.

The front end portion of the drum shaft 7a is rotatably supported by a bearing 7e, which is solidly fixed to a bearing case 7c. Further, the bearing case 7c is solidly fixed to the frame of the process cartridge.

[Charging Means]

The charging means in this embodiment employs one of the contact type charging methods. It employs a charging member 8a, for example, a charge roller.

Referring to Figure 2, the charge roller 8a is rotatably supported by a pair of bearings (unshown), at the lengthwise end portions of its metallic core 8b. It is kept pressured toward the photoconductive drum 7 by a pair of compression springs 8d; it is kept in contact with the peripheral surface of the photoconductive drum 7, so that a

predetermined amount of contact pressure is maintained between the photoconductive drum 7 and the charge roller 8a. It is rotated by the rotation of the photoconductive drum 7.

Designated by a referential number 8c is a cleaning unit for cleaning the charge roller 8a. The charge roller cleaning unit 8c in this embodiment has a flexible cleaning film 8e, which extends in the lengthwise direction of the charge roller 8a, in parallel to the charge roller 8a. The cleaning film 8e is solidly fixed, by one of the long edges thereof, to a supporting member 8f which is reciprocally moved a predetermined distance in the lengthwise direction of the charge roller 8a. Thus, as the supporting member 8f is reciprocally moved by an external driving means, the peripheral surface of the charge roller 8a is rubbed by the cleaning film 8e. As a result, the contaminants (minute toner particles, external additive, etc.) adhering to the peripheral surface of the charge roller 8a are removed.

Incidentally, the image forming apparatus in this embodiment is of a cleaner-less type.

[Exposing means]

In this embodiment, the aforementioned photoconductive drums 7 are exposed by the laser exposing means 1Y, 1M, 1C, 1K, one for one. More specifically, as image formation signals are sent to a

given exposing means from the apparatus main assembly 100, a beam of laser light L is projected from the exposing means, while being modulated with the image formation signals, onto the uniformly charged peripheral surface of the photoconductive drum 7, in a manner to scan the peripheral surface of the photoconductive drum 7, selectively exposing the numerous points of the uniformly charged peripheral surface of the photoconductive drum 7 (Figure 1). As a result, an electrostatic latent image in accordance with the image formation information is formed on the peripheral surface of the photoconductive drum 7.

The laser exposing means 1Y, 1M, 1C, and 1K each comprise: a solid laser element (unshown), a polygon mirror 1a, a focusing lens 1b, a reflection mirror 1c, etc.

[Developing Means]

The developing apparatuses 10 (10Y, 10M, 10C, and 10K) each are of a contact type developing apparatus which uses two-component developer (two-component magnetic brush type developing apparatus). Referring to Figure 2, each developing means 10 comprises a development roller 10a, and a magnetic roller 10b disposed within the hollow of the development roller 10a. The development roller 10a holds a layer of developer 1, which is a mixture of carrier and toner, on its peripheral surface. The

developing apparatus 10 also comprises a regulating blade 10c, which is disposed in the adjacencies of the peripheral surface of the development roller 10a, with the presence of a predetermined distance from the development roller 10a. As the development roller 10a is rotated in the direction indicated by an arrow mark, the body of developer on the peripheral surface of the development roller 10a is formed into a thin layer.

The development roller 10a has a pair of spacers (unshown), which are rotatably fitted around its lengthwise ends, one for one, maintaining thereby a predetermined gap between the development roller 10a and photoconductive drum 7. This gap is small enough for the layer of developer formed on the peripheral surface of the development roller 10a to make contact with the peripheral surface of the photoconductive drum 7 during a development operation.

The toner as one of the ingredients in the developer in this embodiment is such toner that is negative in inherent polarity and is 6 μm in average particle diameter. The magnetic carrier as another of the ingredients of the developer in this embodiment is 205 emu/cm^3 in saturation magnetization, and is 35 μm in average particle diameter. The ratio in weight between the toner and carrier in the developer is 6:94. The developer storage portion 10h, in which the

developer is circulated, has two chambers divided by a partitioning wall 10d which extends in the lengthwise direction. It has stirring screws 10eA and 10eB, which are disposed on both sides of the partitioning wall 10d, one for one.

Referring to Figure 4, after being supplied from the developer supply container, the toner falls onto the back end portion (right end portion in drawing) of the stirring screw 10eB, and is conveyed frontward of the apparatus while being stirred. Then, it is moved through the gap between the front wall of the developer storage portion 10h and the partitioning wall 10d, and then, is conveyed backward of the developer storage portion 10h by the stirring screw 10eA. Then, it is moved through the gap between the back wall of the developer storage portion 10h and the partitioning wall 10d. In other words, the developer is repeatedly circulated by the stirring screws 10eB and 10eA in the developer storage portion 10h. Incidentally, the front side is the side on which a drum shaft positioning plate 25 is present, and the back side is the side on which the rear plate 23 is present.

As the toner is consumed by the development of an electrostatic latent image, the toner content of the developer decreases. In this embodiment, a sensor 10g for detecting the toner content is disposed in the

adjacencies of the peripheral surface of a developer sending member 10cB. As it is detected by the sensor 10g that the toner content of the developer has reduced below a predetermined level, a command for supplying the developing apparatus 10 with the toner from the toner supply container is issued to initiate a toner supplying operation, which maintains the toner content of the developer in the developing apparatus at a predetermined level.

[Fixing Portion]

A developer image formed on the photo-conductive drum 7 by the above described developing means 10 is transferred onto the recording medium 2 by way of the intermediary transfer belt 4a. Then, the fixing device 5 fixes the developer image having just been transferred onto the recording medium 2, to the recording medium 2.

Referring again to Figure 1, the fixing apparatus 5 is provided with a fixing roller 5a for applying heat to the recording medium 2, and a pressure roller 5b for pressing the recording medium 2 against the fixing roller 5a. After the fixation, the recording medium 2 is discharged out of the apparatus main assembly 100 by the discharge rollers 3h and 3j, and is accumulated in the delivery tray 6 on top of the apparatus main assembly 100.

[Developer (toner) Supply Container]

Next, referring to Figures 1 - 3, and Figures 4 - 11, the development supply container in accordance with the present invention will be described.

The development supply containers 12 (12Y, 12M, 12C, and 12K) are disposed in parallel above the process cartridges (10Y, 10M, 10C, and 10K), and are mounted into the apparatus main assembly 100 from the front side of the apparatus main assembly 100 (Figures 1 and 3).

Incidentally, designated by referential numbers 12Y, 12M, 12C, and 12K are developer supply containers for storing yellow, magenta cyan, and black toners, respectively.

Referring to Figures 3 and 5, each of the development supply containers 12 (12Y, 12M, 12C, and 12K) has a developer storage portion 12k, which stores toner within its frame 12r. Within the developer storage portion 12k, a developer sending top member 12b comprising a stirring shaft 12c and a plurality of stirring plates solidly fixed to the stirring shaft 12c, and a developer sending bottom member (screw) 12a, are disposed. The bottom wall of the developer storage portion 12k is provided with a developer outlet 12f having a developer releasing opening 12f1 through which the toner is discharged. The developer sending members 12a and 12b are rotatably supported by their lengthwise ends. The developper sending bottom

member 12a is provided with a driving force receiving portion (female coupling) 12e2, which is attached to one of the lengthwise ends of the bottom developer sending member 12a, and the stirring shaft 12e is provided with a driving force receiving portion (female coupling) 12e1), which is attached to one of the lengthwise ends of the stirring shaft 12c. The driving force receiving portions (female couplings) 12e1 and 12e2 receive the driving force transmitted from the driving force transmitting members (male couplings) 24a and 24b of the apparatus main assembly 100, and are rotated thereby.

The screw as the developer sending member 12a comprises a central shaft, and two pieces of spiral ribs attached to the central shaft in a manner to wrap the center shaft, with the presence of a gap between the two spiral ribs. The position of the gap corresponds to that of the aforementioned developer outlet 12f. The spiral rib on one side of this gap is opposite to the spiral rib on the other side, in the direction in which the spiral ribs are twisted (Figure 5). The developer sending member 12a is rotated in the predetermined direction by the rotation of the driving force transmitting member (male driving coupling) 24b, sending therefore the toner toward the developer outlet 12f. As a result, the toner free falls through the developer releasing opening of the

developer outlet 12f into the cartridge 10 (10Y, 10M, 10C, and 10K); in other words, the cartridge 10 is supplied with the toner.

The peripheral edge, that is, the outermost edge of each stirring plate of the developer sending member 12b, in terms of the rotational radius of the developer sending member 12b, is angled relative to the stirring shaft 12c (Figure 5). Thus, as each stirring plate rubs against the internal surface (internal surface of toner storage portion 12k) of the developer supply container 12 (12Y, 12M, 12C, and 12K), its peripheral edge portion is angled at certain degrees relative to its base portion. More specifically, the peripheral edge portion of the stirring plate is spirally twisted. Thus, as the peripheral edge portion of each stirring plate of the developer sending member 12c is spirally twisted as the developer sending member 12b is rotated, the developer is conveyed in the direction parallel to the shaft of the stirring shaft 12c; the toner is sent in the lengthwise direction.

To theorize the manner in which the amount of the toner in the toner supply container 12 (12Y, 12M, 12C, and 12K) reduces, if the toner is discharged primarily from the adjacencies of the aforementioned developer outlet 12f, an inverse conical hole is created in the body of toner in the toner supply

container 12; the toner is not uniformly supplied from the entire range of the toner supply container 12. Uneven toner reduction such as the above described one is not desirable for supplying the developing apparatus with toner at a constant rate.

In this embodiment, however, the toner is conveyed to the toner outlet 12f as described before. Therefore, the toner is supplied (discharged) at a constant rate.

Each of the development supply containers 12 (12Y, 12M, 12C, and 12K) is provided with an IC memory unit 12, which is attached to the leading end thereof in terms of the direction in which the developer supply container 12 is mounted. In the IC memory unit 12, the data regarding the development supply container and the main assembly of the developing apparatus, are stored, making possible the data communication between the communication control board 31 on the main assembly side, and the developer supply container 12.

Not only can the development supply container in this embodiment supply toner to a process cartridge, or a development cartridge, based on a two-component developing method, but also to a process cartridge or a development cartridge based on a single-component developing method. Further, the powder to be stored in the development supply

container does not need to be limited to toner. For example, it may be the so-called developer, that is, a mixture of toner and magnetic carrier, which is needless to say.

In other words, in this specification, developer means toner as well as a mixture of toner and magnetic carrier. Therefore, the developer supply container in accordance with the present invention includes a developer supply container which supplies only toner as developer, and also, a developer supply container which supplies the so-called developer, that is, a mixture of toner and magnetic carrier.

[Mounting of Process Cartridge and Developer Supply Container]

Next, referring to Figures 2, 3, 5, 7, and 10, the sequential steps through which the process cartridges 10 or developer supply containers 12 are mounted into the image forming apparatus main assembly 100 will be described.

Referring to Figure 3, the apparatus main assembly 100 is provided with a door (front door) 27, which is located in the front panel of the apparatus main assembly 100 and can be freely opened or closed. As an operator opens the door 27 frontward, openings 100a and 100b through which the process cartridges 10 and development supply containers 12 (12Y, 12M, 12C, and 12K), are inserted, respectively, are exposed.

The opening 100b through which the process cartridges 10 are inserted is provided with the drum shaft positioning plate 25, which is rotatably supported. Thus, when inserting or removing the cartridge 10, this drum shaft positioning plate 25 must be opened and closed.

Referring to Figures 2 and 7, there are solidly disposed four pairs of guides 21 for guiding the cartridge 10 when mounting the cartridge 10, and four pair of guides 20 for guiding the developer supply container 12 when mounting the developer supply container 12, in the apparatus main assembly 100.

The direction in which the process cartridge 10 is mounted into the apparatus main assembly 100 is parallel to the axial line of the photoconductive drum 7. The direction in which developer supply container 12 is mounted is parallel to the axial line of the developer sending member (screw) 12a. Further, the directions in which the guides 21 and 20 of the main assembly extend are the same as those in which the process cartridge 10 and development supply containers 12 are mounted. When mounting the process cartridge 10 or developer supply container 12 into the apparatus main assembly 100, first they are slid into the apparatus main assembly 100 along the guides 21 and 20 from the front side of the apparatus main assembly 100. As for the cartridge 10, as it reaches the

deepest end of the apparatus main assembly 100, the deepest end of the drum shaft 7a, that is, the leading end of the drum shaft 7a, in terms of the direction in which the cartridge 10 is inserted, fits into the drum shaft positioning shaft 26 of the apparatus main assembly 100, whereby the deepest end of the photoconductive drum 7 is accurately positioned relative to the apparatus main assembly 100 in terms of its rotational axis. At the same time, the flange 7b engages with the driving coupling 10m, making it possible for the photoconductive drum 7 to be rotationally driven. Further, the rear wall 23 of the apparatus main assembly 100 is provided with four cartridge positioning portions 22 for positioning the cartridges 10Y, 10M, 10C, and 10K. Each positioning portion 22 of the apparatus main assembly 100 enters the recess 9d1 of the frame 10f of the inserted cartridge 10, whereby the leading end of the cartridge 10, in terms of the direction in which the cartridge is inserted, is accurately fixed in its position relative to the apparatus main assembly 100.

On the front side of the apparatus main assembly 100, the drum shaft positioning plate 25, which is rotationally opened or closed, is disposed, with which the bearing case 7c of the cartridge 10 is solidly engaged. Through the above described sequence of operational steps, the photoconductive drum 7 and

cartridge 10 are accurately positioned relative to the apparatus main assembly 100.

In other words, the aforementioned drum shaft 7a, drum flange 7b, portion 9d1 with a recess, and bearing case 7c, constitute together the means for accurately positioning the cartridge 10 relative to the apparatus main assembly 100.

In comparison, referring to Figures 5 - 7, as the developer supply container 12 is inserted as far as it can be, that is, as it reaches the deepest end of the apparatus main assembly 100, a second positioning portion (supporting pin) 22a protruding from the rear wall 23 of the apparatus main assembly 100 enters the second positioning portion (portion with relatively deep blind hole) 12r1 on the end wall of the frame 12r of the developer supply container 12, at the leading end, whereby the position of the developer supply container 12 relative to the apparatus main assembly 100 in terms of the horizontal direction is fixed. Also, the first positioning portion (supporting pin) 22b protruding similarly from the rear wall 23 of the apparatus main assembly 100 enters the first positioning portion 12r2 (portion with blind hole) on the end wall of the frame 12r of the developer supply container 12, located at the deepest end of the apparatus main assembly 100, at the moment. As a result, the position of the leading end

of the developer supply container 12, in terms of the direction in which the developer supply container 12 is inserted, relative to the apparatus main assembly 100, is fixed. At the same time, the driving force receiving portions (female driving couplings) 12e1 and 12e2 engage with the driving force transmitting members (male driving couplings) 24a and 24b, making it possible to rotationally drive the developer sending bottom member 12a and developer sending top member 12b.

The developer supply container 12 is provided with an elastic member catching portion 31, as a means for accurately positioning the developer supply container 12 in terms of the direction in which the developer supply container 12 is mounted into, or removed from, the apparatus main assembly 100, which is at the top of the developer supply container 12. Into this elastic force catching member 31, an elastic member 29, that is, a spring, with which a top wall 23b of each of the cartridge insertion chambers is provided, engages, whereby the position of the developer supply container 12 relative to the apparatus main assembly 100 in terms of the direction in which the developer supply container 12 is inserted is accurately fixed. In addition, the resiliency of the elastic member 29 keeps the developer outlet 12f of the developer supply container 12 in contact with

the toner inlet 10i of the cartridge 10 in the apparatus main assembly 100. Further, the developer supply container 12 is kept pressed by the resiliency of a spring 27a, with which the door 27 is provided, from its trailing end (pressure taking area 12v) in terms of the cartridge insertion direction, whereby the developer supply container 12 is kept pressured forward in terms of the cartridge insertion direction, assuring that the first and second positioning portions 12r2 and 12r1 of the developer supply container 12 do not disengage from the first and second positioning portions 22b and 22ac of the apparatus main assembly 100, respectively, and that the couplings 12e1 and 12e2 do not disengage from the couplings 24a and 24b, respectively.

Further, as the developer supply container 12 is mounted into the apparatus main assembly 100, the trailing ends of the first and second container guides 12g1 and 12g2 of the developer supply container 12 are supported by the pair of the guides 20 of the apparatus main assembly 100.

In other words, the development supply containers 12Y, 12M, 12C, and 12K are accurately positioned relative to the apparatus main assembly 100 by the first and second positioning portions 22a and 22b of the apparatus main assembly 100, and first and second containing positioning portions 12r1 and 12r2

of the developer supply container 12. As for the driving force, it is transmitted by the couplings 12e1 and 12e2, and the driving force transmitting members 24a and 24b.

In summary, as the development supply containers 12(12Y, 12M, 12C, and 12K) are mounted into the apparatus main assembly 100, they are accurately positioned relative to the apparatus main assembly 100 in the following manner.

First, the first and second container positioning portions 12r1 and 12r2 of the developer supply container 12 engage with their counterparts, preventing the developer supply container 12 from rotating in the direction intersectional to the direction in which the developer supply container 12 is mounted. The second container positioning portion of the developer supply container engages with its counterpart. As a result, the leading end of the container 12 is accurately positioned relative to the apparatus main assembly 100. Further, the trailing side of the first and second guides 12g1 and 12g2 of the container 12 are supported by the guides 20 of the apparatus main assembly 100, whereby the trailing end of the container 12 is accurately positioned relative to the apparatus main assembly 100. Further, the container 12 is kept pressured downward by the resiliency of the elastic member 29, by the elastic

force bearing member 31 of the top wall of the container 12, being thereby prevented from floating, and also, assuring that the developer outlet 12f remains in contact with the developer inlet 10i. Further, the container 12 is kept pressured forward, in terms of the cartridge insertion direction, from behind by the resiliency of the spring 27a of the door 27, which presses on the pressure-bearing portion 12v, that is, the end wall of the container 12, on the trailing side, whereby it is assured that the positioning portions 12r1 and 12r2 of the container 12 remain engaged with the positioning portions 22a and 22b of the apparatus main assembly 100, respectively. Incidentally, the couplings 12e1 and 12e2 mesh with the couplings 24a and 24b, respectively, transmitting thereby the driving force.

Next, the structure for opening or closing the developer outlet when mounting or dismounting the developer supply container 12 into the apparatus main assembly 100 will be described.

Referring to Figure 7, the apparatus main assembly 100 is provided with a projection 68, which projects into the path through which the developer supply container 12 is inserted into the apparatus main assembly 100. Thus, as the developer supply container 12 is inserted, this projection 68 comes into contact with the cover 30 of the developer supply

container 12. The arrow mark designated by a referential character X shows the direction in which the developer supply container 12 is mounted into the apparatus main assembly 100.

Referring to Figures 6 and 8, as the developer supply container 12 is inserted, the cover 30 is guided by the rail 12q of the developer supply container 12, being thereby moved toward the trailing end of the developer supply container 12. As a result, the opening 12f1 of the developer outlet 12f is exposed as shown in Figure 6.

Figure 10 is a drawing for showing the operational movement of a closing member (shutter) 12f3. Figures 10(a) - 10(c) show the sequential steps through which the cartridge 10 is inserted into the apparatus main assembly 100 in which the developer supply container 12 is already present. Figures 10(d) - 10(f) show the sequential steps through which the toner supply container 12 is mounted into the apparatus main assembly 100 in which the cartridge 10 is already present.

Referring to Figures 10(d) - 10(f), as the developer supply container 12 is inserted into the apparatus main assembly in which the cartridge 10 is already present, the engagement portion (guiding pin) 10e4 attached to the front side (trailing end side) of the cartridge 10 is caught by the cartridge catching

portion (slit) 12f3c of the closing member 12f3 (Figure 10(d)). In this state, the rotational phase of the second hole 12f3b of the closing member 12f3 relative to the first opening 12f5 (fourth hole 12f2b) is 90°. Therefore, the first opening 12f5 is blocked by the closing member 12f3. Designated by a referential number 12f2c is a slit, which is a part of the closing member 12f3. The engaging portion 10e4 of the cartridge 10 fits into this slit 12f2c. Designated by a referential number 12f2 is a pressing member.

As the developer supply container 12 is inserted deeper, the closing member 12f3 begins to be rotated in the direction indicated by an arrow mark β, about the rotational axle 12f3a (Figures 10(e)). Then, as the container 12 is further inserted to its final position, the closing member 12f3 is rotated to the position shown in Figure 10(f), causing the first opening 12f5 (fourth hole 12f2b) to align with the second hole 12f3b of the closing member 12f3, and therefore, allowing the toner to be supplied from the container 12.

In comparison, referring to Figures 10(a) - 10(c), as the cartridge 10 is inserted into the apparatus main assembly 100 in which the developer supply container 12 is already present, the engaging portion 10e4 attached to the rear end (leading end) of

the cartridge 10 engages into the cartridge catching portion 12f3c of the closing member 12f3 (Figure 10(a)). In this state, the rotational phase of the second hole 12f3b of the closing member 12f3 relative to the first opening 12f5 (fourth hole 12f2b) is 90°. Therefore, the first opening 12f5 is blocked by the closing member 12f3.

As the cartridge 10 is inserted deeper, the closing member 12f3 begins to be rotated in the direction indicated by an arrow mark a, about the rotational axle 12f3a (Figures 10(b)). Then, as the cartridge 10 is further inserted to its final position, the closing member 12f3 is rotated to the position shown in Figure 10(c), causing the first opening 12f5 (fourth hole 12f2b) of the toner supply container 12 to align with the second hole 12f3b of the closing member 12f3, and therefore, allowing the toner to be supplied from the container 12.

Incidentally, when the developer supply container 12 and cartridge 10 are in the state shown in Figures 10(c) and 10(f), the first opening 12f5 of the developer supply container 12 and the opening 10b1 of the developer inlet 10b of the cartridge 10 are aligned with each other, which is needless to say.

Designated by a referential number 12f2 is a pressing member, which is structured and attached so that it is allowed to make a slight vertical movement,

or slightly tilt, relative to the bottom wall of the developer supply container 12. Therefore, while the developer supply container 12 is inserted, the pressing member 12f2 moves in a manner to conform to the shape of the sealing member of the process cartridge 10, preventing the toner from scattering from the container 12.

The descriptions of the preferred embodiment of the present invention given above may be summarized as follows:

The developer supply container 12, which is removably mountable in the electrophotographic image forming apparatus main assembly 100 in order to supply the process cartridge 10 having the electrophotographic photoconductive drum 7 and the charging member 8a for charging the electrophotographic photoconductive drum 7, with the developer t while the process cartridge 10 is in the apparatus main assembly 100, comprises:

the developer storage portion 12k for storing the developer t;

the developer releasing opening 12f1 through which the developer t in the developer storage portion 12k is supplied into the process cartridge 10;

the container closing member 12f3 capable of taking the blocking position in which it blocks the developer releasing opening 12f1, and the position

into which it retreats from the blocking position to expose the developer releasing opening 12f1;

the first guide 12g1 which is located on one of the walls of the developer supply container 12 intersectional with the lengthwise direction of the developer supply container 12, extending in the lengthwise direction of the developer supply container 12, and which is guided by the one of the guides 20 of the apparatus main assembly 100 when the developer supply container 12 is mounted into the apparatus main assembly 100;

the second guide 12g2 which is located on the other wall of the developer supply container 12 intersectional with the lengthwise direction of the developer supply container 12, extending in the lengthwise direction of the developer supply container 12, and which is guided by the other guide 20 of the apparatus main assembly 100 when the developer supply container 12 is mounted into the apparatus main assembly 100;

the cartridge catching portion 12f3c, by which the engaging portion 10e4 of the process cartridge 10 is caught as the developer supply container 12 is mounted into the apparatus main assembly 100, and which bears the force for moving the closing member 12f3 from the closed position to the open position to expose the developer releasing

opening 12f1; and

the first container positioning portion 12r2, which is located at the leading end of the developer supply container 12 in terms of the direction in which the developer supply container 12 is mounted into the apparatus main assembly 100 (direction indicated by arrow mark X in Figures 5 and 7), and accurately positions the developer supply container 12 relative to the apparatus main assembly 100 by engaging with the container positioning portion 22b of the apparatus main assembly 100;

wherein when the developer supply container 12 is mounted into the apparatus main assembly 100, the developer supply container 12 is accurately positioned relative to the apparatus main assembly 100, as the first container positioning portion 12r2 is positioned by the first container positioning portion 22b of the apparatus main assembly 100, and the trailing end portions of the first and second container guides 12g1 and 12g2, in terms of the cartridge mounting direction, are supported by the pair of container guides 20 of the apparatus main assembly 100, respectively.

The first container positioning portion 12r2 of the developer supply container 12 has a cylindrical hole, whereas the first container positioning portion 22b of the apparatus main assembly 100 is in the form

of a cylindrical projection, the external diameter of which is approximately the same as the internal diameter of the cylindrical hole of the first container positioning portion 12r2 of the developer supply container 12, so that the the first container positioning portion 22b of the apparatus main assembly 100 fits into the first container positioning portion 12r2 of the developer supply container 12.

Further, the wall of the developer supply container 12, which faces upward when the developer supply container 12 is in the apparatus main assembly 100, has the elastic member catching portion 31, which comes into contact with the elastic member 29 of the apparatus main assembly 100 and bears the force from the elastic member 29. Therefore, when the developer supply container 12 is in the apparatus main assembly 100, it is kept pressured downward, whereby it is assured that the developer outlet 12f remains perfectly connected with the toner inlet 10i.

Further, the leading end of the developer supply container 12, in terms of the direction in which the container is mounted, is provided with the second container positioning portion 12r1, which is above the first container positioning portion 12r2. The second container positioning portion 12r1 engages with the second container positioning portion 22a of the apparatus main assembly 100, with the presence of

no gap in terms of the horizontal direction, but with the presence of a gap between the top of the second container positioning portion 22a of the apparatus main assembly 100, and the opposing portion of the second container positioning portion 12r1 of the developer supply container 12, accurately positioning the developer supply container 12 relative to the apparatus main assembly 100 in terms of the horizontal direction, and therefore, preventing the developer supply container 12 from rotating in the direction intersectional to the lengthwise direction, when the developer supply container 12 receives the driving force transmitted from the apparatus main assembly 100.

The cartridge catching portion 12f3c is a portion of the closing member 12f3 having a slot into which the engaging portion 10e4 of the cartridge 10 caught when the developer supply container 12 is mounted into the apparatus main assembly 100. As the developer supply container 12 is inserted into the apparatus main assembly 100 (in the direction of arrow mark X), the cartridge catching portion 12f3c is pushed by the closing member engaging portion 10e4 of the cartridge 10, causing thereby the closing member 12f3 to move to the open position. In other words, as the container 12 is mounted into the apparatus main assembly 100, the developer releasing opening 12f1 is

automatically exposed.

The developer supply container 12 is also provided with the cover 30, which is movable between the position in which it covers the developer releasing opening 12f1 of the bottom wall of the developer storage portion 12k, and the position into which it retracts. As the developer supply container 12 is inserted into the apparatus main assembly 100, the cover 30 engages with the cover engaging portion 68 of the apparatus main assembly 100, being thereby moved from the developer container closing position to its retreat. With the provision of this structural arrangement, as the developer supply container 12 is inserted into the apparatus main assembly 100, the cover 30 which prevents the developer from scattering from the developer releasing opening 12f1 is automatically retracted.

Further, the developer storage portion 12k has the top and bottom chambers 12k2 and 12k3 separated by the partitioning member 12k1 (Figure 5), which is provided with a hole 12k4 for allowing the developer t in the top chamber 12k2 to fall into the bottom chamber 12k3. The top and bottom chambers 12k2 and 12k3 are provided with developer sending top and bottom members 12b and 12a, respectively. The developer sending top member 12b is rotated to send the developer t to the partitioning member hole 12kr

(arrow mark Y in Figure 5 indicates developer movement). The developer sending bottom member 12a is rotated to send the developer t to the developer releasing opening 12f1. The leading end of the developer supply container 12, in terms of the direction in which the developer supply container 12 is mounted into the apparatus main assembly 100, is provided with a driving force receiving top portion 12e1 through which the developer sending top member 12b receives the rotational driving force from the driving force transmitting member of the apparatus main assembly 100, and a driving force receiving bottom portion 12e2 through which the developer sending bottom member 12a receives the rotational driving force from the driving force transmitting member of the apparatus main assembly 100. When the process cartridge 10 is in the apparatus main assembly 100, the second container positioning portion 12r1, driving force receiving portion 12e1, first container positioning portion 12r2, and driving force receiving bottom portion 12e2, of the developer supply container 12 are located in the listed order, from the top. This positional arrangement improves the degree of accuracy with which the driving force receiving portions 12e1 and 12e2 are positioned relative to the apparatus main assembly 100.

The cartridge guides 12g1 and 12g2 extend in

the lengthwise direction of the developer supply container 12 across virtually the entire range of the developer supply container 12.

The developer supply container 12 has a handle 12x, which is a part of the top portion of the upstream end portion of the developer supply container 12 in terms of the development supply container insertion direction. The handle 12x is the portion to be grasped by an operator when the operator pulls out the developer supply container 12 from the apparatus main assembly 100.

In the case in which the process cartridge 10 is mounted into the apparatus main assembly 100 in which the developer supply container 12 is already present, as the process cartridge 10 is inserted into the apparatus main assembly 100, the cartridge catching portion 12f3c is pushed by the process cartridge 10, causing thereby the closing member 12f3 to move from the closed position to the opening position. In other words, as the process cartridge 10 is inserted into the apparatus main assembly 100, the developer releasing opening 12f1 is automatically exposed.

Further, the position of the developer supply container 12 relative to the apparatus main assembly 100 is fixed, because the position of the first container positioning portion 12r2 is fixed by the

first container positioning portion 22b of the apparatus main assembly 100, and the positions of the trailing ends of the first and second container guides 12g1 and 12g2, in terms of the development supply container insertion direction, relative to the apparatus main assembly 100, are fixed by being supported by the container guides 20 of the apparatus main assembly 100. Therefore, the end portion of the developer supply container 12 having the first container positioning portion 12r2 is positioned at a slightly higher level than the trailing end of the developer supply container 12. More specifically, in this embodiment, the developer supply container 12 is set in the apparatus main assembly 100 so that its leading end is positioned 300 μm - 1.0 mm higher than the trailing end. With the provision of this arrangement, the container 12 remains in contact with the apparatus main assembly 100 at three areas (A, B, and C areas in Figures 9 and 11), remaining thereby accurately positioned.

Further, in this embodiment, when the container 12 is mounted into the apparatus main assembly 100, the first container positioning portion 12r2 with the cylindrical wall engages with the first container positioning portion 22b of the apparatus main assembly 100 in the form of a pin, while being moved upward by the tapered end portion of the pin

22b. Therefore, the position of the container 12 relative to the apparatus main assembly 100 is fixed, with its leading end positioned 300 μm - 1.0 mm higher than the trailing end. With the provision of this structural arrangement, the container positioning portion 12r2 of the leading end of the developer supply container 12 engages with the container positioning portion 22b of the apparatus main assembly 100 (area A in Figures 9 and 11), and the trailing end of the developer supply container 12 is supported by the guides 20 of the apparatus main assembly 100, by the trailing end portions of the container guides 12g1 and 12g2 (areas B and C in Figures 9 and 11). In other words, the position of the container 12 relative to the apparatus main assembly 100 is fixed by the three areas A, B, and C, which are comparable to the apexes of a roughly isosceles triangle. Therefore, it is assured that the container 12 is reliably supported by the apparatus main assembly 100 while being accurately positioned relative to the apparatus main assembly 100.

The container positioning portions 12r1 and 12r2 on the end wall of the developer supply container 12, on the leading side, are approximately in the middle of the container 12 in terms of the width direction of the container 12. Further, the container guide 12g1 is on one of the two walls of the container

12 (developer storage portion 12k) perpendicular to the width direction of the container 12, extending in the lengthwise direction, and the container guide 12g2 is on the other, also extending in the lengthwise direction.

Further, the trailing end portion of the developer supply container 12 is provided with the pressure bearing portion 12v, which is kept pressed by the resiliency of the spring 27a attached to the door 27 of the image forming apparatus main assembly 100, when the position of the first container positioning portion 12r2 is fixed by the first container positioning portion 22b of the apparatus main assembly 100, and the trailing ends of the first and second container guides 12g1 and 12g2, in terms of the development supply container insertion direction are supported by the guides 20 of the apparatus main assembly 100, one for one, whereby the position of the developer supply container 12 relative to the apparatus main assembly 100 is fixed. With the provision of this structural arrangement, the container 12 remains pressured in the direction in which the developer supply container 12 is inserted into the apparatus main assembly 100, assuring that the driving force receiving portions 12e1 and 12e2 remain properly engaged with the driving force transmitting members 24a and 24b.

According to the above described embodiment of the present invention, the developer releasing opening, cartridge catching portion, elastic force bearing portion, driving force receiving top portion, and driving force receiving bottom portion, of the developer supply container 12 are located on the leading end side, in terms of the container insertion direction, with respect to the center of the developer supply container 12 in terms of the lengthwise direction of the developer supply container 12, and the first container positioning portion located at the leading end of the container 12 engages with the container positioning portion of the apparatus main assembly 100. Therefore, the leading end side of the container 12 is more accurately positioned relative to the apparatus main assembly 100. In addition, since the above listed functional and structural portions are parts of the leading end side of the container 12, the container 12 can be positioned relative to the apparatus main assembly 100 with a degree of accuracy sufficient in practical terms, with the provision of a simple structural arrangement.

The development supply container in this embodiment includes a container for supplying developer, as well as toner, used in electrophotography. For example, it includes a container for supplying single-component developer, a container for

supplying two-component developer, and a container for supplying toner alone when developer is a mixture of toner particles and carrier particles.

The electrophotographic image forming apparatus for forming an image on the recording medium 2 comprises:

(i) the cartridge spaces S1 into which the process cartridge 10 having the charging member 8a for charging the photoconductive drum 7 is removably mounted;

(ii) the pair of container guides 20; and

(iii) the developer supply container chambers S2 into which the development supply containers 12 comprising: the developer storage portion 12k for storing developer; the developer releasing opening 12f1 through which the developer t in the developer storage portion 12k is supplied into the process cartridge 10; the container closing member 12f3 capable of taking the blocking position in which it blocks the developer releasing opening 12f1, and the position into which it retreats from the blocking position to expose the developer releasing opening 12f1; the first guide 12g1 which is located on one of the walls of the developer supply container 12 intersectional with the lengthwise direction of the developer supply container 12, extending in the lengthwise direction of the developer supply container

12, and which is guided by one of the pair of guides 20 of the apparatus main assembly 100, when the developer supply container 12 is mounted into the apparatus main assembly 100; the second guide 12g2 which is located on the other wall of the developer supply container 12 intersectional with the lengthwise direction of the developer supply container 12, extending in the lengthwise direction of the developer supply container 12, and which is guided by the other guide 20 of the apparatus main assembly 100, when the developer supply container 12 is mounted into the apparatus main assembly 100; the cartridge catching portion 12f3c, into which the engaging portion 10e4 of the process cartridge 10 engages as the developer supply container 12 is mounted into the apparatus main assembly 100, and which catches and bears the force for moving the closing member 12f3 from the closed position to the open position to expose the developer releasing opening 12f1; and the first container positioning portion 12r2, which is located at the leading end of the developer supply container 12 in terms of the direction in which the developer supply container 12 is mounted into the apparatus main assembly 100 (direction indicated by arrow mark X in Figures 5 and 7), and accurately positions the developer supply container 12 relative to the apparatus main assembly 100 by engaging with the

container positioning portion 22b of the apparatus main assembly 100, wherein when the developer supply container 12 is mounted into the apparatus main assembly 100, the developer supply container 12 is accurately positioned relative to the apparatus main assembly 100, as the position of the first container positioning portion 12r2 is fixed by the first container positioning portion 22b of the apparatus main assembly 100, and the trailing end portions of the first and second container guides 12g1 and 12g2 of the developer supply container 12 are supported by the pair of guides 20 of the apparatus main assembly 100, one for one, respectively, are removably mounted; and

(iv) the conveying members (3b, 3c, 3d, and 3g) for conveying the recording medium 2.

According to the above described embodiment, the container positioning portion of the leading end of the development supply container is accurately positioned relative to the apparatus main assembly, and the trailing ends of the first and second container guides of the development supply container are supported by the pair of container guides of the apparatus main assembly. Therefore, the development supply container is accurately positioned relative to the image forming apparatus main assembly.

As described above, according to the present

invention, it is possible to accurately position a developer supply container relative to the main assembly of an image forming apparatus.

While the invention has been described with reference to the structures disclosed herein, it is not confined to the details set forth, and this application is intended to cover such modifications or changes as may come within the purposes of the improvements or the scope of the following claims.